AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

Claim 1 (Currently amended): A high-frequency heating apparatus for driving a magnetron, comprising:

a DC power supply including an AC power supply, a rectifier circuit for rectifying a voltage of the AC power supply, and a smoothing capacitor for smoothing an output voltage of the rectifier circuit;

a series circuit including two semiconductor switching devices, the series circuit being connected in parallel to the DC power supply;

a resonance circuit connected to a primary winding of a leakage transformer and a capacitor, one end of the resonance circuit being connected to a middle point of the series circuit while the other end of the resonance circuit is connected to one end of the DC power supply;

a drive unit for driving each of the semiconductor switching devices;

a frequency-modulated signal generation unit operable to transmit a frequency-modulated signal;

a lowest frequency limiting unit for establishing a lowermost limit of a frequency at which the semiconductor switching devices are to be operated, wherein the lowest limit frequency limiting unit establishes the lowermost limit as a first frequency when the high-frequency heating apparatus is activated and gradually lowers the lowermost limit to a second frequency that is less than the first frequency in response to activation of the high-frequency heating apparatus;

a comparison unit for comparing the frequency-modulated signal to the lowermost limit as the lowermost limit is being gradually lowered by the lowest frequency limiting unit, wherein the comparison unit transmits a comparison result signal indicating which of the frequency-modulated signal and the lowermost limit is greater, the comparison result signal to be communicated to the drive unit for controlling operation of the semiconductor switching devices;

a rectifier unit connected to a secondary winding of the leakage transformer;

a magnetron connected to the rectifier unit; and

a dead time generation circuit for turning off the semiconductor switching devices concurrently,

wherein the drive unit ~~has a function of limiting the lowest frequency of a frequency with which the semiconductor~~

~~switching devices are driven, so that the lowest frequency is set to a first frequency at the beginning of operation of the high-frequency heating apparatus, and the lowest frequency is set to a second frequency which is lower than the first frequency gradually thereafter~~ is operable to drive the semiconductor switching devices based on the comparison result signal transmitted by the comparison unit.

Claim 2 (Currently amended): A high-frequency heating apparatus for driving a magnetron, comprising:

a DC power supply including an AC power supply, a rectifier circuit for rectifying a voltage of the AC power supply, and a smoothing capacitor for smoothing an output voltage of the rectifier circuit;

two series circuits each including two semiconductor switching devices, each of the series circuits being connected in parallel to the DC power supply;

a resonance circuit connected to a primary winding of a leakage transformer and a capacitor, one end of the resonance circuit being connected to a middle point of one of the series circuits while the other end of the resonance circuit is connected to a middle point of the other series circuit;

a drive unit for driving each of the semiconductor switching devices;

a frequency-modulated signal generation unit operable to transmit a frequency-modulated signal;

a lowest frequency limiting unit for establishing a lowermost limit of a frequency at which the semiconductor switching devices are to be operated, wherein the lowest limit frequency limiting unit establishes the lowermost limit as a first frequency when the high-frequency heating apparatus is activated and gradually lowers the lowermost limit to a second frequency that is less than the first frequency in response to activation of the high-frequency heating apparatus;

a comparison unit for comparing the frequency-modulated signal to the lowermost limit as the lowermost limit is being gradually lowered by the lowest frequency limiting unit, wherein the comparison unit transmits an comparison result signal indicating which of the frequency-modulated signal and the lowermost limit is greater, the comparison result signal to be communicated to the drive unit for controlling operation of the semiconductor switching devices;

a rectifier unit connected to a secondary winding of the leakage transformer;

a magnetron connected to the rectifier unit; and

a dead time generation circuit for turning off the semiconductor switching devices concurrently,

wherein the drive unit ~~has a function of limiting the lowest frequency of a frequency with which the semiconductor switching devices are driven, so that the lowest frequency is set to a first frequency at the beginning of operation of the high-frequency heating apparatus, and the lowest frequency is set to a second frequency which is lower than the first frequency gradually thereafter~~ is operable to drive the semiconductor switching devices based on the comparison result signal transmitted by the comparison unit.

Claim 3 (Currently amended): A high-frequency heating apparatus for driving a magnetron, comprising:

a DC power supply including an AC power supply, a rectifier circuit for rectifying a voltage of the AC power supply, and a smoothing capacitor for smoothing an output voltage of the rectifier circuit;

a series circuit including two semiconductor switching devices, the series circuit being connected in parallel to the DC power supply;

a resonance circuit connected to a primary winding of a leakage transformer and a capacitor, the resonance circuit being

connected in parallel to one of the semiconductor switching devices;

a drive unit for driving each of the semiconductor switching devices;

a frequency-modulated signal generation unit operable to transmit a frequency-modulated signal;

a lowest frequency limiting unit for establishing a lowermost limit of a frequency at which the semiconductor switching devices are to be operated, wherein the lowest limit frequency limiting unit establishes the lowermost limit as a first frequency when the high-frequency heating apparatus is activated and gradually lowers the lowermost limit to a second frequency that is less than the first frequency in response to activation of the high-frequency heating apparatus;

a comparison unit for comparing the frequency-modulated signal to the lowermost limit as the lowermost limit is being gradually lowered by the lowest frequency limiting unit, wherein the comparison unit transmits a comparison result signal indicating which of the frequency-modulated signal and the lowermost limit is greater, the comparison result signal to be communicated to the drive unit for controlling operation of the semiconductor switching devices

a rectifier unit connected to a secondary winding of the leakage transformer;

a magnetron connected to the rectifier unit; and

a dead time generation circuit for turning off the semiconductor switching devices concurrently,

wherein the drive unit ~~has a function of limiting the lowest frequency of a frequency with which the semiconductor switching devices are driven, so that the lowest frequency is set to a first frequency at the beginning of operation of the high-frequency heating apparatus, and the lowest frequency is set to a second frequency which is lower than the first frequency gradually thereafter~~ is operable to drive the semiconductor switching devices based on the comparison result signal transmitted by the comparison unit.

Claim 4 (Currently amended): The high-frequency heating apparatus according to claim 1, further comprising:

an error signal generation circuit for generating an error signal from a difference between an input current of the AC power supply and a reference current; and

[[a]] wherein the frequency-modulated signal generation ~~circuit for correcting~~ unit corrects a rectified voltage/rectified current obtained by rectifying the AC power

supply, based on an output (error signal) of the error signal generation circuit, an output of the frequency-modulated signal generation circuit being supplied to the dead time generation circuit;

wherein [[a]] the lowest frequency limiting ~~circuit~~ unit is inserted between the frequency-modulated signal generation circuit and the dead time generation circuit~~, the lowest frequency limiting circuit supplies a limited frequency to the dead time generation circuit based on the output signal of the frequency-modulated signal generation circuit so that a set frequency of the lowest frequency limiting circuit is set to be higher than the output of the frequency-modulated signal generation circuit at the beginning of operation of the aforementioned high-frequency heating apparatus, and in accordance with time having passed since the beginning of operation, the limited frequency is lowered gradually, while with lowering of the limited frequency, a signal higher in switching frequency of the limited frequency and the output signal of the frequency-modulated signal generation circuit is selected as a signal to be supplied to the dead time generation circuit in accordance with time having passed, so that the selected signal is changed over gradually to the output signal of the frequency-modulated signal generation circuit~~.

Claim 5 (Original): The high-frequency heating apparatus according to claim 4, wherein the lowest frequency limiting circuit has a capacitor, the capacitor is charged during suspension of the high-frequency heating apparatus, and as soon as the high-frequency heating apparatus begins to operate, a voltage of the capacitor is supplied to the dead time generation circuit, and charges accumulated in the capacitor are discharged.

Claim 6 (Previously presented): The high-frequency heating apparatus according to claim 4, wherein the dead time generation circuit generates a fixed or marginally increased dead time regardless of a switching frequency.

Claim 7 (Previously presented): The high-frequency heating apparatus according to claim 1, wherein the dead time generation circuit generates a dead time increased in accordance with increase of a switching frequency.

Claim 8 (Original): The high-frequency heating apparatus according to claim 7, wherein the dead time generation circuit

fixes or marginally increases the dead time at a switching frequency not higher than a predetermined frequency.

Claim 9 (Previously presented): The high-frequency heating apparatus according to claim 7, wherein the dead time generation circuit suddenly increases the dead time at a switching frequency not lower than a predetermined frequency.

Claims 10-12 (Canceled)

Claim 13 (Previously presented): The high-frequency heating apparatus according to claim 1, wherein the dead time generation circuit generates a dead time based on positive and negative offset voltages each varying with a first inclination in proportion to increase of a switching frequency and varying with a second inclination when the switching frequency reaches a predetermined frequency or higher.

Claim 14 (Previously presented): The high-frequency heating apparatus according to claim 1, wherein the dead time generation circuit includes a VCC power supply, a duty control power supply, a first current varying in proportion to a switching frequency, a second current flowing at a predetermined

frequency at beginning and varying in proportion to the switching frequency, a third current obtaining by and multiplying a combining current of the two currents by a predetermined coefficient, and a upper and lower potential generation unit for generating a set of upper and lower potentials obtained by adding positive and negative offset voltages proportional to the third current, to the duty control power supply respectively, and a dead time is generated based on the set of upper and lower potentials.

Claim 15 (Canceled)

Claim 16 (Currently amended): The high-frequency heating apparatus according to claim 2, further comprising:

an error signal generation circuit for generating an error signal from a difference between an input current of the AC power supply and a reference current; and

[[a]] wherein the frequency-modulated signal generation ~~circuit for correcting~~ unit corrects a rectified voltage/rectified current obtained by rectifying the AC power supply, based on an output (error signal) of the error signal generation circuit, an output of the frequency-modulated signal

generation circuit being supplied to the dead time generation circuit;

wherein [[a]] the lowest frequency limiting ~~circuit~~ unit is inserted between the frequency-modulated signal generation circuit and the dead time generation circuit~~, the lowest frequency limiting circuit supplies a limited frequency to the dead time generation circuit based on the output signal of the frequency-modulated signal generation circuit so that a set frequency of the lowest frequency limiting circuit is set to be higher than the output of the frequency-modulated signal generation circuit at the beginning of operation of the aforementioned high-frequency heating apparatus, and in accordance with time having passed since the beginning of operation, the limited frequency is lowered gradually, while with lowering of the limited frequency, a signal higher in switching frequency of the limited frequency and the output signal of the frequency-modulated signal generation circuit is selected as a signal to be supplied to the dead time generation circuit in accordance with time having passed, so that the selected signal is changed over gradually to the output signal of the frequency-modulated signal generation circuit~~.

Claim 17 (Previously presented): The high-frequency heating apparatus according to claim 16, wherein the lowest frequency limiting circuit has a capacitor, the capacitor is charged during suspension of the high-frequency heating apparatus, and as soon as the high-frequency heating apparatus begins to operate, a voltage of the capacitor is supplied to the dead time generation circuit, and charges accumulated in the capacitor are discharged.

Claim 18 (Previously presented): The high-frequency heating apparatus according to claim 16, wherein the dead time generation circuit generates a fixed or marginally increased dead time regardless of a switching frequency.

Claim 19 (Previously presented): The high-frequency heating apparatus according to claim 2, wherein the dead time generation circuit generates a dead time increased in accordance with increase of a switching frequency.

Claim 20 (Previously presented): The high-frequency heating apparatus according to claim 19, wherein the dead time generation circuit fixes or marginally increases the dead time

at a switching frequency not higher than a predetermined frequency.

Claim 21 (Previously presented): The high-frequency heating apparatus according to claim 19, wherein the dead time generation circuit suddenly increases the dead time at a switching frequency not lower than a predetermined frequency.

Claim 22 (Previously presented): The high-frequency heating apparatus according to claim 2, wherein the dead time generation circuit generates a dead time based on positive and negative offset voltages each varying with a first inclination in proportion to increase of a switching frequency and varying with a second inclination when the switching frequency reaches a predetermined frequency or higher.

Claim 23 (Previously presented): The high-frequency heating apparatus according to claim 2, wherein the dead time generation circuit includes a VCC power supply, a duty control power supply, a first current varying in proportion to a switching frequency, a second current beginning to flow at a predetermined frequency and varying in proportion to the switching frequency, a third current obtaining by and

multiplying a combining current of the two currents by a predetermined coefficient, and a upper and lower potential generation unit for generating two upper and lower potentials obtained by adding positive and negative offset voltages proportional to the third current, to the duty control power supply respectively, and a dead time is generated based on the two upper and lower potentials.

Claim 24 (Currently amended): The high-frequency heating apparatus according to claim 3, further comprising:

an error signal generation circuit for generating an error signal from a difference between an input current of the AC power supply and a reference current; and

[[a]] wherein the frequency-modulated signal generation ~~circuit for correcting~~ unit corrects a rectified voltage/rectified current obtained by rectifying the AC power supply, based on an output (error signal) of the error signal generation circuit, an output of the frequency-modulated signal generation circuit being supplied to the dead time generation circuit;

wherein [[a]] the lowest frequency limiting ~~circuit~~ unit is inserted between the frequency-modulated signal generation circuit and the dead time generation circuit~~, the lowest~~

~~frequency limiting circuit supplies a limited frequency to the dead time generation circuit based on the output signal of the frequency-modulated signal generation circuit so that a set frequency of the lowest frequency limiting circuit is set to be higher than the output of the frequency-modulated signal generation circuit at the beginning of operation of the aforementioned high-frequency heating apparatus, and in accordance with time having passed since the beginning of operation, the limited frequency is lowered gradually, while with lowering of the limited frequency, a signal higher in switching frequency of the limited frequency and the output signal of the frequency-modulated signal generation circuit is selected as a signal to be supplied to the dead time generation circuit in accordance with time having passed, so that the selected signal is changed over gradually to the output signal of the frequency-modulated signal generation circuit~~.

Claim 25 (Previously presented): The high-frequency heating apparatus according to claim 24, wherein the lowest frequency limiting circuit has a capacitor, the capacitor is charged during suspension of the high-frequency heating apparatus, and as soon as the high-frequency heating apparatus begins to operate, a voltage of the capacitor is supplied to the

dead time generation circuit, and charges accumulated in the capacitor are discharged.

Claim 26 (Previously presented): The high-frequency heating apparatus according to claim 24, wherein the dead time generation circuit generates a fixed or marginally increased dead time regardless of a switching frequency.

Claim 27 (Previously presented): The high-frequency heating apparatus according to claim 3, wherein the dead time generation circuit generates a dead time increased in accordance with increase of a switching frequency.

Claim 28 (Previously presented): The high-frequency heating apparatus according to claim 27, wherein the dead time generation circuit fixes or marginally increases the dead time at a switching frequency not higher than a predetermined frequency.

Claim 29 (Previously presented): The high-frequency heating apparatus according to claim 27, wherein the dead time generation circuit suddenly increases the dead time at a switching frequency not lower than a predetermined frequency.

Claim 30 (Previously presented): The high-frequency heating apparatus according to claim 3, wherein the dead time generation circuit generates a dead time based on positive and negative offset voltages each varying with a first inclination in proportion to increase of a switching frequency and varying with a second inclination when the switching frequency reaches a predetermined frequency or higher.

Claim 31 (Previously presented): The high-frequency heating apparatus according to claim 3, wherein the dead time generation circuit includes a VCC power supply, a duty control power supply, a first current varying in proportion to a switching frequency, a second current beginning to flow at a predetermined frequency and varying in proportion to the switching frequency, a third current obtaining by and multiplying a combining current of the two currents by a predetermined coefficient, and a upper and lower potential generation unit for generating two upper and lower potentials obtained by adding positive and negative offset voltages proportional to the third current, to the duty control power supply respectively, and a dead time is generated based on the two upper and lower potentials.